

Chapter 9 Annunciation Systems

9-1. General

EPRI EL-5036, Volume 10, provides guidelines and considerations in planning and designing annunciation systems for power plants.

9-2. Audio and Visual Signals

Every power plant should be provided with an annunciation system providing both audible and visual signals in the event of trouble or abnormal conditions.

a. Audio signals. Howler horns and intermittent gongs are used for audible signal devices. An intermittent gong is provided in the plant control room. Howler horns are used in the unit area and in areas where the background noise is high (e.g., in the turbine pit) or in areas remote from the unit (e.g., plant switchyard).

b. Visual signals. Visual signals are provided by lighted lettered window panels of the annunciator. In larger plants, the annunciator panel indication is augmented by unit trouble lamps located in a readily visible position close to the unit. The plant sequence of events recorder (SER) is normally located in the control room. Separate annunciators (when provided) for station service systems and switchyards should be located on associated control panels of the station service switchgear or on the switchyard control panels.

9-3. Annunciator

a. General. The annunciator system should be designed for operation on the ungrounded 125-V DC system discussed in Chapter 11. All remote contacts used for trouble annunciation should be electrically independent of contacts used for other purposes so annunciator circuits are separated from other DC circuits. Auxiliary relays should be provided where electrically independent contacts cannot otherwise be obtained. The annunciator equipment should use solid-state logic units, lighted-window or LED type, designed and tested for surge withstanding capability in accordance with ANSI C37.90.1, and manufactured in accordance with ANSI/ISA S18.1.

b. The switchboard annunciator operational sequence should be a manual or automatic reset sequence as listed in Table 9-1.

Automatic reset should be employed when there is either an SER or a SCADA system backup. When the plant is controlled and dispatched through the SCADA system of the wheeling utility, the design reset features of the annunciator should be coordinated to ensure proper operation.

c. The generator switchboard is provided with annunciator alarm points for unit emergency shutdown, generator differential lockout, generator incomplete start, generator or 15-kV bus ground, generator overspeed, generator overcurrent, generator breaker low pressure, unit control power loss, generator CO₂ power off, PT fuse failure or undervoltage, and head cover high water.

Table 9-1
Switchboard Annunciator Operational Sequence

Field Contact	Control Pushbutton or Switch	Alarm Lights	Horn	Auxiliary or Repeater Contacts
Normal	--	Off	Off	Off
Abnormal		Flashing	On	On
Abnormal	Acknowledge or Silence	On	Off	On
Normal	Reset	Off	Off	Off
Normal	Test	On	Off	Off

Certain alarm points have several trouble contacts in parallel by equipment group. Examples include generator excitation system trip or trouble, turbine bearing oil trouble, generator cooling water flow, unit bearing overheat, generator oil level, generator stator high temperature, and governor oil trouble.

- d. The generator switchboard may be provided with an additional annunciator for the generator step-up transformer and unit auxiliary equipment alarms, depending on the plant arrangement. Generally, these alarm points are transformer differential, transformer lockout trip, transformer overheat, transformer trouble, 480-V switchgear trip, and trouble.
- e. The generator excitation cubicle is provided with an annunciator for excitation equipment alarm points for AC regulator trip, bridge overtemperature, transformer over temperature, regulator power supply, field overvoltage, maximum excitation limit, minimum excitation limit, and volt per Hertz. Generator overvoltage, power system stabilizer, and fan failure alarm points should be included when required.

f. The switchboard annunciator for large power plants should be provided with auxiliary or repeater contacts to drive control room console remote annunciator word-indicating lights.

g. A control console window-indicating light annunciator is common to all units. One unit at a time can be selected by use of the appropriate unit trouble status lighted pushbutton. Visual indication is provided when the unit switchboard annunciator is activated. The console window indicating lights are generally grouped by switchboard annunciator points and provide essential trouble status to the operator. Unit troubles are normally categorized by shutdown, differential, overcurrent, cooling water, bearing oil, unit trouble, breaker air, CO₂ discharge, control power, and head cover high water. The

window indicating light annunciator provides backup for a sequential event recorder. Unit switchboard annunciator remote control switches to silence and reset the switchboard annunciator should be provided on the control console.

9-4. Sequence of Events Recorder (SER)

An SER should be provided to complement the plant annunciation system if a SCADA system is not performing the sequence of events function. The SER provides a time-tagged, sequenced, printed record of trouble events. The documented record of a trouble event aids in diagnosing power plant forced outages. It is designed for operation on an ungrounded 125-V DC system. All inputs should be optically isolated and filtered for 125-V DC dry contact change-of-state scanning. The SER minimum resolution should be coordinated with using agencies. A value of 2 msec is typical. When an input signal status change occurs, the SER should automatically initiate and produce a tabulated printed record on the data logger identifying the event and showing the time of status change (to the nearest millisecond). The SER should be provided with a system clock and time synchronization features. Each SER system should be provided with an adequate input point capacity to monitor each alarm trouble contact and provide plant breaker status necessary for the plant operation. The alarm trouble contacts should include IEEE 1010 requirements and project alarm points requirements.

9-5. Trouble Annunciator Points

All of the alarm points listed in Table 9-2 below are not required in every plant, and, conversely, requirements for an unlisted alarm point may arise. IEEE 1010 provides types of alarm signals transmitted to the generator annunciator from the generator, excitation system, generator terminal cabinet, generator breaker, step-up transformer, turbine, and governor, which are listed in Table 9-2.

Table 9-2
Alarm Signals Transmitted to the Generator Annunciator

Generator Switchboard Annunciator Points	
Signal	Description
86GX & 86GT	Unit Emergency Shutdown
87GX	Generator Differential Shutdown
48TDC	Generator Incomplete Start
64X	Generator or 15-kV Bus Ground
12G	Generator Overspeed
51GAR	Generator Overcurrent
63	Generator Breaker Low Pressure

(Continued)

Table 9-2. (Continued)

<u>Generator Switchboard Annunciator Points</u>	
<u>Signal</u>	<u>Description</u>
74CB	Control Power Loss
63X	CO ₂ Discharge
27CO ₂	CO ₂ Power Off
27G	PT Fuse Fail or Undervoltage
71HC	Head Cover High Water
*	Generator Regulator Trip or Trouble
*	Turbine Bearing Oil Trouble
*	Generator Cooling Water Flow
*	Unit Bearing Oil Trouble
*	Generator Oil Level
*	Generator Stator High Temperature
*	Governor Oil Trouble

* See IEEE 1010

<u>Step-Up Transformer Annunciation Points</u>	
<u>Signal</u>	<u>Description</u>
87TAR	Transformer Differential
86L	Transformer Lockout Trip (Includes Transformer Ground)
74TL	Transformer Control Power Loss
*	Transformer Overheat
*	Transformer Trouble
20TDX	Transformer Deluge

* See IEEE 1010

<u>Line Annunciation Points</u>	
<u>Signal</u>	<u>Description</u>
94L1	Line Lockout
74	Line Relay or MW Power Off
74	Microwave Trouble

<u>Station Service Transformer Annunciation Points</u>	
<u>Signal</u>	<u>Description</u>
86T	Transformer Lockout
63G,49,26Q,71Q	Transformer Trouble
94	Transformer Breaker Tripped
63X	CO ₂ Discharge

<u>Station Annunciation Points</u>	
<u>Signal</u>	<u>Description</u>
86BD	Station Service Switchgear Bus Differential
BA	Station Service Switchgear DC Trouble

<u>Station Annunciation Points</u>	
<u>Signal</u>	<u>Description</u>
63	Station Service Switchgear Breaker Low Pressure
94	Station Service Feeder Breaker Tripped

(Continued)

Table 9-2. (Concluded)

BA	480-V AC Feeder Breaker Tripped
64,BA	Bus Tie Breaker Tripped or Trouble
74	Battery Charger Failure
BA	125-V DC Feeder Breaker Tripped
64,74,27	125-V DC System Tripped
64,74,27	48-V DC System Trouble
BA	48-V DC Feeder Breaker Trip
74,83	Inverter Trouble
71	Unwatering Pump Trouble
71	Drainage Pump Trouble
71	Septic Tank High Level
71	Effluent High Level
63	Station Air Low Pressure
63	Oil or Paint Storage Room CO ₂ Discharge
27	Fire Pump Power Off
42	Fire Pump On
74,71	Engine Generator Trouble
94	Engine Generator Trip
74	Plant Intrusion Detector

Switchyard Annunciation Points

<u>Signal</u>	<u>Description</u>
63	Power Circuit Breaker Loss of Tripping and Closing Energy
63	Power Circuit Breaker Energy Storage System Energy
27	Breaker Close Bus Failure
27	Breaker Trip Bus Failure
86	Breaker Failure Lockout Relay
27	Relay Potential Failure
21	Line Distance Relay Trip
50/51L	Line Overcurrent Relay Trip
64L	Line Ground Relay Trip
94L	Microwave Transfer Trip
74	MWTT Trouble
86BD	Bus Failure Lockout Relay
74	Line Communication Trip
42	Transformer Cooling Fan Failure
49	Transformer Overheat
71G	Transformer Gas Accumulator
71Q	Transformer Oil Level
63Q	Transformer Sudden Pressure Relay
51G	Transformer Ground Detector
63G	Transformer Inert Air Tank Pressure
86T	Transformer Lockout Relay
87T	Transformer Phase Differential
50/51T	Transformer Phase Overcurrent

Switchyard Annunciation Points

<u>Signal</u>	<u>Description</u>
50G	Transformer Neutral Overcurrent
28	Transformer Fire
74	Battery Charger Trouble
27,64,74	Battery Trouble
74,83	Inverter Trouble
42	Engine Generator Running
71,74	Engine Generator Trouble
74	Yard Intrusion Detector